BULLETIN

OF THE INSTITUTE OF METALS

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INSTITUTE NEWS

1961 Autumn Meeting

The 1961 Autumn Meeting of the Institute will be held in Brussels from Monday to Saturday, 18–22 September, by invitation of the Union des Industries de Métaux Non-Ferreux.

Travel and hotel arrangements are being made by Thos. Cook and Son, Ltd., Post Order Department, Berkeley Street, London, W.1, who have made reservations so that the majority of those attending the meeting may stay at the same hotel (Metropole) if they so desire.

Papers on Industrial Uses

Although it has been rare in recent years for papers on industrial uses of materials to appear in the *Journal*, the Editorial Board and Publication Committee consider that such papers are within the Institute's field of interest and wish to encourage their submission. Broadly speaking, these papers would deal with the performance of materials in engineering components and structures or with the physical, mechanical, or heat- and corrosion-resisting requirements for metals in specific engineering fields.

The field of industrial uses may be broken down into general categories such as, for example, the following: power engineering, shipbuilding, the aircraft industry, the electronics industry, the automobile industry, the petroleum industry, the chemical industry, and the metal-extraction industry.

The papers, dealing only with specific problems falling within these broad categories, should be written primarily from the viewpoint of engineering requirements and should emphasize the particular properties required in materials, the extent to which these are met by present-day metals and alloys, and what further improvements are desirable, including improvements in manufacturing techniques needed to produce the desired properties. The author might also outline future trends in the industry and, in particular, those which are dependent upon the development of new materials.

It is not the intention that such papers should take the form of a " Metallurgical Review ". They should not attempt to do anything other than to state the present position and speculate on the future, drawing attention to materials that will be required to make specific advances in a particular field.

Lecture on " Metallurgical Research at High Pressures "

A lecture on " Metallurgical Research at High Pressures " was given by Dr. J. E. Hilliard (General Electric Research Laboratory, Schenectady, N.Y.) at a general meeting of the Institute held on 12 January 1961 at 17 Belgrave Square, London, S.W.1. The lecture was given under the auspices of the Metal Physics Committee, which has been responsible for organizing a number of lectures by visiting scientists in recent years.

Dr. Hilliard said that the metallurgist now had available equipment capable of sustaining pressures of 2×10^6 lb/in^2 at very high temperatures and more than 7×10^6 lb/in^2 at room temperatures. This extension of the pressure range was the result of developments made in the last ten years, the most notable being the use of pyrophyllite for gaskets and as a pressure-transmitting medium.

One possible application of high-pressure techniques in metallurgy was the production of new types of alloys either by modifying the properties of existing ones or by the creation of entirely new phases. Because of present limitations in equipment, such commercial applications would be restricted to materials which, like diamond, were usable in small quantities and could command a high price.

A second application and, so far in metallurgy the more fruitful one, had been the use of pressure as an extra thermodynamic variable. Measurement of the pressure-dependence of some property provided a check on theories developed on the basis of other data and, in the case of a complex kinetic process, such as precipitation, it might identify the rate-controlling step.

In interpreting the effect of pressure treatment on metals and alloys, two factors had to be considered. One was the change induced in the phase equilibria and the other the effect on kinetic processes. An important example of the former was the increase with pressure in the stability of γ-iron. This led to a depression of the $\gamma \longrightarrow \alpha$ transformation temperature in pure iron (from 910° C at atmospheric pressure to ~570° C at 70 kilobars) and to an extension of the γ-loop in ferrous systems. Pressure also decreased the solubility of cementite in austenite; at 32 kilobars the eutectoid point in the iron–carbon system lay at about 0·35% carbon.

The application of pressure decreased atomic mobility and therefore produced a slowing-up in many kinetic processes. In a recent study of five binary systems, it had been found that pressure reduced the rate of precipitation by factors varying from four to a thousand. In general, these decreases could be correlated with the expected changes in the appropriate diffusion coefficients. However, an anomaly had been observed with respect to the growth of pearlite in a commercial steel containing 1% manganese. Under a pressure of 32 kilobars, the growth rate of pearlite was decreased by a factor of 700, whereas in a high-purity steel only a five-fold decrease was observed.

Other examples of the effect of pressure on kinetic processes included a decrease in the rate of recrystallization in metals and a reduction in the thermal mobility of dislocations in lithium fluoride.

Binding of " Journals "

Mr. W. A. Newark, who for a number of years has undertaken the binding of the *Journal*, &c., for members, retired at the end of 1960. His business has been acquired by Mr T. W. Lovett, who will be pleased to receive binding work from members. The address is: 2 Clerkenwell Green, London, E.C.1.

Election of Members

The following 16 Ordinary Members, 2 Junior Members, and 7 Student Members were elected on 9 December 1960:

As Ordinary Members

BENNETT, John A., A.B., M.S., Chief, Mechanical Metallurgy Section, National Bureau of Standards, Washington, D.C., U.S.A.

BRYSON, Neil Burton, M.A.Sc., Ph.D., Research Engineer, Aluminium Laboratories, Ltd., Kingston, Ont., Canada.

CUCCHINI, Eugenio, Dott.ing.chim., Procuratore, Lavorazione Leghe Leggere S.p.A., Milan, Italy.

DAHLSTROM, Roy, A.B., Ph.D., Director of Research, National Lead Co., New York, N.Y., U.S.A.

DUCKWORTH, Walter Eric, M.A., A.I.M., Head of Metallurgy (General) Division, British Iron and Steel Research Association, London.

ERTHAL, John Frederick, B.S., Naval Air Material Centre, Aeronautical Materials Laboratory, Philadelphia, Pa., U.S.A.

IANNIELLO, Louis, M.Met.E., Ph.D., Assistant Metallurgist, Metallurgy Division, Argonne National Laboratory, Argonne, Ill., U.S.A.

IRIBERRI, Jorge Rafael, Dr.en Quim., Director Tecnico, Industrias Quimetal S.R.L., Buenos Aires, Argentina.

MURRAY, Peter, B.Sc., Ph.D., F.R.I.C., F.I.Ceram., Head, Metallurgy Division, Atomic Energy Research Establishment, Harwell, Berks.

OLDHAM, William Johnston, Group Steel Liaison Officer, The Owen Organization, Darlaston.

RAY, Howard M., B.Met.E., Supervisor, Metallurgical Laboratory, Bridgeport Brass Co., Riverside, Calif., U.S.A.

TOLLEMACHE, Miles de Orellana, Technical Translator and Abstractor, Lewknor, Oxon.

VALLVE, Juan (Creus), Dr.Ing.Indust., Ingeniero Jefe, Metales y Plateria Ribera S.A., Barcelona, Spain.

VEARS, Michael Gordon, Technical Information Officer, Central Laboratories, The de Havilland Aircraft Co., Ltd., Edgware, Middlesex.

DE VRIES, Hendrik, Mech.Eng., Metallographer, Koninklijke/Shell Laboratorium, Amsterdam, Netherlands.

WINEGARD, William Charles, M.A.Sc., Ph.D., Associate Professor, Department of Metallurgical Engineering, University of Toronto, Canada.

As Junior Members

ANANTHARAJU, Srinivasa Murthy, B.Sc., B.E., Junior Mechanical Maintenance Engineer, Hindustan Steel, Ltd., Durgapur, Bengal, India.

SINGH, Manjit, B.Sc., Lecturer in Metallurgy, College of Mining and Metallurgy, Banaras Hindu University, Varanasi, India.

As Student Members

CAMPBELL, John Keith Rennie, B.Sc., A.R.C.S.T., Research Student, Department of Metallurgy, Royal College of Science and Technology, Glasgow.

FULLERTON-BATTEN, Robert Charles, Undergraduate, Department of Metallurgy, University of Birmingham.

JACKSON, Malcolm William, Junior Research Metallurgist, B.S.A. Group Research Centre, Kitts Green, Birmingham.

MILES, Reginald John, Metallurgist, Wild-Barfield Electric Furnaces, Ltd., Watford.

MUNDIE, John Smith, L.I.M., Metallographer, Enfield Rolling Mills, Ltd., Brimsdown, Middlesex.

SIGSBEE, Raymond A., B.S.M.E., Graduate Student, Department of Chemical and Metallurgical Engineering, University of Michigan, Ann Arbor, Mich., U.S.A.

STEPHENSON, Edwin David, Undergraduate, Department of Metallurgy, King's College, University of Durham, Newcastle-upon-Tyne.

The following 10 Ordinary Members, 4 Junior Members, and 11 Student Members were elected on 30 December 1960:

As Ordinary Members

AZZOLINI, Angelo, Metallindustria, Milano, Italy.

BIANCO, Giacomo, Dott.ing., Dirretore Generale, Fabbrica Italiana Prodotti Sinterizzati (FIPS), Torino, Italy.

GAGEL, Harold Louis, B.S., Research Metallurgist, Wright Air Development Division, United States Air Force, Wright-Patterson Air Force Base, Ohio, U.S.A.

HARRIS, Sydney George, M.A.Sc., Ph.D., P.Eng., Assistant Commercial Secretary, Office of the High Commissioner for Canada, London.

MARSHALL, Gordon Shiels Walker, T.D., C.A., Secretary and Chief Accountant, Capper Pass and Son, Ltd., North Ferriby, Yorks.

MICHELL, David, Managing Director, Holman, Michell and Co., Ltd., St. Helens, Lancs.

NASH, Ralph Robert, M.S., Ph.D., Office of Naval Research, United States Embassy, London.

V. RADERS, *Baron* Herman Andries, Foundry Technical Assistant, LIPS Metal Works, Drunnen, Netherlands.

SIMS, Walter H. R., Supervisor, Heat-Treatment Department, The de Havilland Aircraft Co., Ltd., Lostock, Lancs.

VENTURELLO, *Professor* Giovanni, Dott., Professore di Scienza dei Metalli, Università di Torino, Italy.

As Junior Members

GREBETZ, John, M.S., Research Assistant, University of Wisconsin, Madison, Wis., U.S.A.

HARTLEY, Craig Sheridan, B.Met.E., Research Metallurgist, WWRCMP-2, United States Air Force, Wright-Patterson Air Force Base, Ohio, U.S.A.

JONES, Albert William, B.Sc., Physical Metallurgist, The General Electric Co., Ltd., A.E.D. Materials Laboratory, Erith, Kent.

STANSFIELD, William Alan, Metallurgical Assistant, Monk Bridge Iron and Steel Co., Leeds.

As Student Members

BOWEN, David Keith, Undergraduate, Department of Metallurgy, University of Oxford.

HUGHES, Thomas Alan, Undergraduate, Department of Metallurgy, University of Leeds.
JACKSON, Michael David, Undergraduate, Department of Metallurgy, University of Manchester.
JONES, David Jones, Undergraduate, Department of Metallurgy, University of Leeds.
NORTHROP, Ian Thomas, Undergraduate, Department of Metallurgy, University of Leeds.
PARKER, Brian, Undergraduate, Department of Metallurgy, University of Leeds.
PARSONS, Paul Donald, Undergraduate, Department of Metallurgy, University of Leeds.
PATERSON, Leonard John, B.Sc., A.R.C.S.T., Research Student, Department of Metallurgy, Royal College of Science and Technology, Glasgow.
ROUND, Graham George, Round Oak Steel Works, Brierley Hill; Student, Birmingham College of Advanced Technology, Birmingham.
STUCHFIELD, Michael Frank, Undergraduate, Department of Metallurgy, University of Leeds.
WEBBER, John Henry, Undergraduate, Department of Metallurgy, University of Leeds.

PERSONAL NOTES

MR. R. P. ABENDROTH is now a research scientist in the metallurgy section, general research division of Owens-Illinois Glass Co., Toledo, Ohio.

MR. M. A. J. ASTON has left the Royal Air Force and taken up an appointment at the Wantage Research Laboratory of the U.K. Atomic Energy Authority.

MR. E. S. BUNN, chief metallurgist of Revere Copper and Brass Inc., has been appointed general manager of the Company's research and development department in Rome, N.Y.

DR. R. CABOZ has been appointed Chef du Laboratoire d'Electrochimie, Centre de Recherche de la S.N.P.A., Pau (B.-P.).

DR. J. M. CAPUS has joined the staff of Gillette Industries, Ltd., Research Laboratories, Reading.

DR. R. G. COPE has left The Mond Nickel Co., Ltd., to become Senior Research Investigator in charge of Process Research with The Glacier Metal Co., Ltd., Kilmarnock.

MR. F. R. COWLISHAW has been appointed works metallurgist to Steel Cords, Ltd., Derby.

MR. L. M. FITZGERALD has left Cambridge to return to Australia. He has taken up an appointment in the Physics and Chemistry of Surfaces Section of the Chemical Laboratories of C.S.I.R.O., Melbourne.

DR. R. W. FOUNTAIN has been appointed manager of metals research, technology department, Union Carbide Metals Co., Niagara Falls, N.Y.

MR. J. R. FREEMAN, JR., Vice-President in charge of metallurgy and research of the American Brass Co., has retired after 30 years' service with the Company. He will in future act as metallurgical consultant to Anaconda Sales Co. and represent Anaconda in the Copper Products Development Association.

MR. D. GARFORTH has taken up a post with the National Smelting Co., Ltd., Avonmouth.

MR. W. W. GLICK has been appointed Works Manager of H. J. Maybrey and Co., Ltd., London, S.E.26. He was previously on the staff of the British Non-Ferrous Metals Research Association.

DR. W. C. HAHN, JR., is now Assistant Professor of Metallurgy at the Montana School of Mines.

MR. P. M. KELLY has left Cambridge and is now at the University of Leeds.

MR. T. M. KESSEL has left British Insulated Callender's Cables, Ltd., to take up an appointment with Engelhard Industries, Ltd., London.

DR. C. H. MATHEWSON, Professor Emeritus of Metallurgy and Metallography at Yale University, has received the newly established Albert Easton White Award of the American Society for Metals.

DR. R. B. MEARS has been appointed Assistant Vice-President, Applied Research, United States Steel Corp., Pittsburgh, Pa.

DR. D. R. MILLER has left Cambridge and returned to the University of Melbourne.

MR. G. K. NOTMAN has left the Department of Metallurgy at Cambridge and is now at the Graham Research Laboratory, Jones and Laughlin Steel Co., Pittsburgh, Pa.

MR. G. W. PARRY has taken up an appointment in the Metallurgy Division of Atomic Energy of Canada, Ltd., Chalk River, Ont.

DR. H. W. PAXTON, Associate Professor of Metallurgical Engineering at the Carnegie Institute of Technology, has received the Bradley Stoughton Award of the American Society for Metals for outstanding young teachers of metallurgy.

MR. D. E. PEACOCK has left the Royal School of Mines and is now with Gillette Industries, Ltd., Research Laboratories, Reading.

PROFESSOR F. N. RHINES, Head of the Metallurgical Research Laboratory at the University of Florida, has been awarded, with Mr. J. B. CLARK, of Dow Chemical Co., the Henry Marion Howe Medal, the oldest honour of the American Society for Metals.

MR. V. G. RIVLIN has left Oxford and is now with the Fulmer Research Institute, Stoke Poges.

MR. J. S. ROBERTS has left the American Manganese Bronze Co., Philadelphia, to become assistant superintendent in the Foundry and Propeller Shop of the Bethlehem Steel Co., Staten Island, N.Y.

DR. H. N. SINKA has been elected a Member of Council of the Indian Institute of Metals and Secretary of the Bombay Chapter of the Institute.

MR. R. LEWIS STUBBS, Director of the Zinc Development Association, has been appointed Director-General of the Lead Development Association and the Zinc Development Association.

MR. G. A. TRUSSLER has left the Mining Research Establishment of the National Coal Board and joined English Electric Co., Ltd., Atomic Power Division, Whetstone.

LETTERS TO THE EDITOR

What Should the Institute Publish?

Mr. G. L. Bailey, in his interesting letter in the January issue of the *Bulletin*, made several points important both to the Institute and to the profession of metallurgy.

As regards the interest of members in what is published, I think part of the trouble is that too few papers are published in any given monthly issue of the *Journal*. Their number is so very small, compared with the range and variety of interests of metallurgists as a whole, that there is little chance of a paper turning up in a given issue on a specific topic of interest. If the number of papers published each month could be greatly increased, say to about thirty, while keeping a balance between the various parts of the subject, there would then be things in every issue of direct interest to everyone, even the most specialized, and the feelings which have prompted Mr. Bailey's letter would, I believe, mostly disappear. Probably a much shorter type of paper, perhaps only two pages long, would then become the rule. This would have the advantage of encouraging a livelier style of writing, quicker to the point and less accommodating to tedious detail, in such papers.

Turning to the wider issues raised by Mr. Bailey, I think it would be a great mistake to divide the *Journal* so as to recognize a split between the scientific and practical sides of the subject. In such an applied science as metallurgy neither the science nor the industry can flourish without each other; the first would become pointless and trivial, the other backward and moribund. The trouble is that the science of metals and alloys is very difficult and has consumed the entire efforts of those who have worked on it. I believe that this phase is passing, however, and that in the next few years we shall see a new type of metallurgical paper in which modern theory is applied to the practical design of new alloys and new metallurgical processes, much in the same way as it is already being applied in semiconductor technology.

I hope the Institute can encourage this type of paper, certainly by arranging more symposia on the practical aspects of metallurgical science, and possibly also by inviting people to submit such papers. It would be necessary to go carefully at first, because the science is not yet good enough to be applied willy-nilly to every practical problem without disaster, but there are now several areas of the subject where a rational discussion of the practical aspects in terms of modern theory is feasible and could be fruitful. Once a pattern has been set for such papers, and a new tradition established, it would become self-sustaining.

A. H. COTTRELL

Department of Metallurgy,
Cambridge.

Tarnishing of Silver and Silver–Silicon Contacts by Hydrogen Sulphide

The tarnishing of silver contacts on telephone relays is generally regarded as being caused by the presence of sulphur compounds in the surrounding atmosphere.

As silver contacts made to the same specification but by different manufacturers showed widely different tarnishing tendencies, even when mounted on the same relay and exposed to the same atmosphere under the same conditions, it was regarded as important to find out why this difference in behaviour occurred. Tarnishing experiments were therefore made on samples of silver and various silver alloys. It was decided to have only one variable, and hydrogen sulphide was chosen. The test specimens were placed in a glass vessel and sufficient hydrogen sulphide was injected twice daily to raise the concentration to 2×10^{-6} each time. The actual amount of hydrogen sulphide injected was so small that it reacted with the silver long before the next injection took place.

The results of the experiments were as follows. The tarnishing properties of the contact material, which consisted of silver alloyed with 1·5% silicon, did not differ from those of pure silver. The small amount of nickel which one manufacturer had introduced to make the contact material more ductile did not have any adverse effects as regards tarnishing. The reason for the great difference in the behaviour of the various contacts was found to be due to the surface treatment. It was conclusively shown that final cleaning with trichlorethylene left the contacts in a highly active state. Tarnishing could be retarded by treatment with a light mineral oil, followed by washing with a neutral soap solution and rinsing with water. The same contacts could be made alternately active or passive at will.

If the results obtained with hydrogen sulphide can be regarded as representative of silver tarnishing by the sulphur compounds normally present in the atmosphere, it seems advisable to avoid drastic cleaning of oily silver contacts after manufacture by means of strong organic solvents. Only the old method of washing with mild soap and subsequent rinsing with lukewarm water should be employed. This result seems also to be corroborated by observations made in practice. A full account of this work, in English, will appear in *Teleteknik*, No. 2 (1960).

H. L. HALSTRØM

Københavns Telefon Aktie Selskab,
Copenhagen,
Denmark.

LECTURES TO LOCAL SECTIONS AND ASSOCIATED SOCIETIES

General Metallurgical Problems in the Motor Industry

At a meeting of the Birmingham Metallurgical Society held on 24 November 1960, Mr. R. J. BROWN (Materials Engineer, The British Motor Corporation, Ltd.) spoke about " General Metallurgical Problems in the Motor Industry ".

Mr. Brown said that the problems were likely to affect the operator on the workshop floor, whose earnings would be reduced by any interference in production rates that might arise, and the factory management, whose programme would be interfered with, rather than the ultimate purchaser of the vehicle. This was due to the care taken in the control and inspection of the materials received by the motor manufacturer, and by the close control maintained over factory processes.

The problems were similar to those in the light engineering industries generally, and were related to the quality or condition of the incoming material, to difficulties arising in processing, to variations in machinability or surface finish, and to distortion in heat-treatment. The principal problem affecting

the user of the finished vehicle was that of corrosion, for the simple reason that the effects of corrosion were so obvious, but the owner himself had some measure of responsibility for preventing the onset of corrosion by providing reasonable maintenance.

The major problem probably related to variability in the response of steel to heat-treatment, particularly surface hardening by H.F. induction methods; the principal control required was on the carbon content, but the residual alloy constituents normally occurring in carbon steels also affected very considerably the hardenability of the steel, and consequently the behaviour of the steel during surface hardening. Control was normally achieved by some form of hardenability test—the Jominy test, the SAC test, or some arbitrary test devised by the user. The practical operating conditions during H.F. treatment also required close control, and a method devised in the Nuffield Central Research Laboratories for exploring the heating and cooling rates during progressive hardening was described.

The relative merits of traditional pack carburizing, refining and hardening, single-quench and direct-quench treatments were discussed in relation to distortion, and the advantages of direct quenching were emphasized. The effect of gross heterogeneity on distortion in heat-treatment and on machining rates was referred to, and reference was also made to the need for some agreed heterogeneity limits.

Decarburization of steel was always undesirable, but particularly so when hot-rolled or bright-drawn stock had to be surface-hardened by H.F. induction methods, and the removal of the necessary decarburized surface layer was extremely wasteful. Machinability of steels was being adversely affected at present by the introduction of large electric melting furnaces, which in many cases were replacing open-hearth furnaces; this was due to their lower sulphur content and their greater cleanliness, and there was a need for steel melted in this way to be sulphurized, to provide a content of between 0·035 and 0·050%.

Thermal checking of surfaces subjected to frictional heating was at times reported, and, in the case of high-performance brake drums, it had been found that a lamellar pearlite matrix was better than an irresolvable pearlite matrix. A laboratory technique was described for evaluating materials, in which samples were subjected to extremely rapid cyclic heating and cooling, using H.F. induction as the means of heating, and this showed the pronounced effect the form of graphite had on thermal checking in the case of grey-iron castings.

Care was necessary during manufacture to avoid corrosion of ferrous materials, and reference was made to the quite reasonable life of the silencer assembly in service as compared with the life of tyres. Cylinder-bore wear resulted from a combination of corrosion and abrasion, but the present combination of surface finish and chromium-plated piston rings ensured a long life. The care taken in providing corrosion-resistance of the body structure was described, and the need for adequately protecting the unseen, as well as the visible, surfaces of the body structure, was emphasized.

Brief reference was made to the "graphitic corrosion" that had been reported with the cast-iron components of Diesel engines, resulting from aeration of the coolant, caused by inadequate maintenance of the various seals, and the relative merits of nickel–chromium plating, stainless iron, and anodized aluminium for the various trim items were discussed, particular reference being made to the merits of the newer plating techniques, involving duplex nickel coatings and the heavier deposits of "crack-free" chromium.

Direct Observation of Dislocations

A lecture entitled "Direct Observation of Dislocations" was delivered to the Southampton Metallurgical Society on 27 October 1960 by Dr. R. B. Nicholson (Department of Metallurgy, University of Cambridge).

The lecture was preceded by a showing of the film: "Experiments with the Bubble Model of a Metal Structure" by Sir Lawrence Bragg, W. M. Lomer, and J. F. Nye. This film showed the motion and interaction of dislocations in a two-dimensional bubble raft and served as a good introduction to the observation of dislocations in metals.

Dr. Nicholson said that the behaviour of individual dislocations in crystals had been studied by many techniques, e.g. etch pits, decoration, and X-ray diffraction, but it was the transmission electron-microscope technique that had provided the most direct picture of dislocations in metals.

The preparation of thin metal foils suitable for transmission microscopy was discussed, and some account was given of the contrast produced in the electron image by lattice discontinuities such as dislocations, stacking faults, and precipitates.

Several applications of the technique were discussed. The lecturer said that it was possible to correlate the dislocation distribution in deformed copper single crystals with the shape of the work-hardening curve, while observations on deformed polycrystals showed that grain boundaries presented strong obstacles to dislocation movement. Another method of introducing dislocations into a metal was by quenching. This produced a large supersaturation of vacant lattice sites in a crystal that might anneal out in various ways. In aluminium, the vacancies collected as discs on close-packed planes, which then collapsed to form small dislocation loops; but in gold a two-stage process led to the formation of tetrahedra of stacking faults. In aluminium alloys the nucleation of defects appeared to be difficult, and the vacancies condensed on screw dislocations to form long helical dislocations. The interaction of dislocations and precipitates could be conveniently studied in the electron microscope, and observations showed that dislocations sheared small coherent precipitates but that they tended to avoid large non-coherent particles.

Finally, the transmission electron-microscope technique had been used to study the motion of dislocations when a stress is applied to a thin foil. This experiment was illustrated by the film "Dislocations and Stacking Faults in Stainless Steel" by P. B. Hirsch, R. W. Horne, and M. J. Whelan.

The Origin, Detection, and Elimination of Gases in Cast Metal

Dr. D. V. Atterton (Managing Director, Foundry Services, Ltd.) lectured on "The Origin, Detection, and Elimination of Gases in Cast Metals" at a joint meeting, on 1 December 1960, of the London Local Section and the London Branch of the Institute of British Foundrymen.

Dr. Atterton began by explaining that he was going to confine his remarks mainly to hydrogen in aluminium alloys, copper alloys, and steel.

After a brief review of the solubility of hydrogen in these metals and of typical contents found in practice, Dr. Atterton dealt in detail with various defects that could arise in castings owing to the presence of excessive quantities of hydrogen.

He then dealt with the various sources of hydrogen during the casting operation and gave considerable emphasis to precautions that should be taken during the melting operation and particularly during metal transfer to the mould in order to minimize gas content in the final cast product.

Various qualitative and quantitative methods for determining the presence and amount of gas in molten metals were described, particular emphasis being given to techniques capable of providing a result before casting was carried out.

The major part of the lecture was concerned with various processes for eliminating gases from aluminium, copper, and steel, and the lecture concluded with the author's views as to possible future developments.

Recent Advances in the Electron Theory of Metals

In a lecture to the Manchester Metallurgical Society on 23 November 1960, Professor G. V. RAYNOR (University of Birmingham) talked of " Recent Advances in the Electron Theory of Metals ".

He said that although the development of electron theory had enabled significant progress to be made in explaining the nature of metals and alloys in terms of Brillouin zones, it had become increasingly evident that the treatment was in need of revision. Some of the evidence, from both theoretical and experimental sources, was discussed, and an indication given of the main features of the more realistic treatments that were now being proposed.

Metals and the Architect

At their meeting on 17 November 1960, members of the Sheffield Local Section heard a lecture on " Metals and the Architect " by Mr. A. DAYKIN (Department of Architecture, University of Sheffield).

Mr. Daykin said that the myriad minor uses of metal in building encouraged complacency and obscured some more fundamental aspects. A review showed a need for a complete reappraisal. Metal was not essential for the creation of architecture.

The great struggle throughout architectural history, however, had been the attempt to enclose and master space, and, although architecture had already attained an august age before the introduction of metals, these materials, more than any others, had enabled the architect to succeed beyond his wildest dreams. It was fascinating to trace the influence of metal upon architectural concepts from the earliest metal tools and piping in Ancient Egypt to the modern metal-clad frame, tensile structures and domes.

The lecturer noted in passing that the possession of iron had not automatically ensured the creation of fine architecture by the Hittites. The Greek use of structural iron in Athens in the second half of the 5th Century B.C. was an experiment of incredible foresight, and the invention of metal-tied triangulated timber structures by the Hellenistic shipbuilders was an almost explosive innovation in the hands of Ionian and, later, Roman architects. In Rome itself, the Emperor Hadrian had been credited with the construction of the 2000-ton bronze trussed roof of the portico to the Pantheon. Contemporary spans of 80–90 ft were also recorded.

The reasons for the decline in the structural use of metals in the Byzantine period were complex, but the scarcity of raw material and the decline of technology during the Dark Ages was sufficient to explain the neglect that had prevailed until the late Gothic period. Examples of the working of bronze and iron in the Gothic period indicated a high level of skill, though major structural uses—as in the Byzantine era—were not demanded by this type of architecture. Two important usages, however, which anticipated present-day practice, were the use of copper and lead as sheathing for timber structures and the construction of glass, lead, and iron membranes in the form of stained-glass windows.

The Renaissance re-explored the structural uses of wrought iron in tension, e.g. the tie-rodding of arcading and the thrust chains within the dome structure of St. Paul's, London. Much research had been lavished recently upon the early structural uses of cast iron in Britain, but it appeared that once again all the quoted instances of its first use in the early Industrial Revolution had been anticipated by the naval architects, for in 1670 Captain, later Sir Anthony, Deane launched the *Royal James*, constructed internally with iron columns, knees, braces, and other components.

The late 18th Century experiments of Strutt and Bage at Belper, Shrewsbury, and Milford had also anticipated the work of Boulton and Watt in Manchester, but the history of the 19th Century was constantly being reviewed and its chief interest lay in the vast intuitive strides made in metal construction during the first half of the century. This had been a great period of innovation. Despite the vauntings of science and the cries of " progress ", the 100 years after 1851 had been largely spent in exploiting, extending, and perfecting the basic achievements of that heroic age. It was only recently that architects had again begun to think basically. Perhaps the competition of reinforced concrete and rising costs had caused interest to veer from metal rectangular frame-structures—lately so dominant—towards structural forms capable of enclosing vast spaces with the minimum amount of material.

In the past it had frequently been the man most closely in contact with elemental forces—the marine constructor—who pioneered the techniques that architects seized upon and developed to fulfil their vision. Today's equivalent was the aircraft constructor and tomorrow's perhaps the builder of space-ships.

JOINT ACTIVITIES

" Automation—Men and Money "

A Conference on this subject will be held at Harrogate from 27 to 30 June 1961, under the ægis of the British Conference on Automation and Computation.

This will be the first British Conference on the Social and Economic Effects of Automation. Further details will be published shortly; meanwhile enquirers should communicate with the Conference Secretary, c/o The British Institute of Management, 80 Fetter Lane, London, E.C.4.

POWDER METALLURGY JOINT GROUP

Winter Meeting 1961

The title of the discussion to be held at this meeting has been altered and is now: " Sintered High-Temperature Oxidation-Resistant Materials." Offers of papers describing original, unpublished work are invited.

OTHER NEWS

Powder Metallurgy Colloquium

A first colloquium on Powder Metallurgy will be held in Buenos Aires during the third week of March 1961. It is being sponsored jointly by the Comisión Nacional de Energia Atómica and by private industry in Argentina.

Enquiries regarding the colloquium should be made to Señor Antonio Carrea, C.N.E.A., Avenida Libertador General San Martin 8250, Buenos Aires, Argentina.

4. Internationale Leichtmetalltagung

The 4. Internationale Leichtmetalltagung will be held in Leoben, Austria, on 20–24 June 1961. The main subject of the meeting will be "Light Metals in Light Structures, in Architecture, and in Special Fields", and there will, in addition, be a number of scientific papers dealing with various aspects of light metals. A provisional programme and other information may be obtained from Geschäftsstelle der 4. Internationalen Leichtmetalltagung, Montanistische Hochschule, Leoben/Stmk., Austria.

DIARY

The Institute

21–23 March. Spring Meeting, Church House, Great Smith Street, London, S.W.1. An outline of the programme was given in the January issue of the *Bulletin*.

21 March. May Lecture by Professor M. Polanyi. (Royal Institution, Albemarle Street, London, W.1, at 6.30 p.m.)

23 March. Annual Dinner and Dance. (Grosvenor House, Park Lane, W.1.)

Local Sections and Associated Societies

2 March. Birmingham Local Section. "Rating Sheet-Metal Formability by Press Performance", by D. H. Lloyd. (College of Technology, Gosta Green, Birmingham 4, at 6.30 p.m.)

2 March. Leeds Metallurgical Society. "Grain Size —Three-Quarters of the Key to Strength?", by Professor N. J. Petch. (University Staff House, University Road, Leeds, at 6.30 p.m.)

2 March. London Local Section. "Progress in the Electron Theory of Metals", by Dr. J. A. Catterall. (17 Belgrave Square, London, S.W.1, at 6.30 p.m.)

4 March. Liverpool Metallurgical Society. Eighth Annual Conversazione (University Club, Liverpool).

7 March. Oxford Local Section. "Novel Methods of Forming Metals", by Dr. J. F. Wallace. (Cadena Café, Cornmarket Street, Oxford, at 7.15 p.m.)

7 March. South Wales Local Section. "Fracture of Metals", by Dr. K. E. Puttick. (Metallurgy Department, University College, Singleton Park, Swansea, at 6.30 p.m.)

8 March. Manchester Metallurgical Society "Solidification and Structure of Cast Iron", by I. C. H Hughes and W. Oldfield. (The Manchester Literary and Philosophical Society, George Street, Manchester, at 6.30 p.m.)

9 March. East Midlands Metallurgical Society. "The Metallurgy of the Steam Turbine", by Dr. L. E. Benson. (Faculty of Applied Science, Clifton Boulevard, The University, Nottingham, at 7.30 p.m.)

9 March. Liverpool Metallurgical Society. "Creep Deformation", by Dr. D. McLean. (Joint Meeting with the Iron and Steel Institute) (Department of Metallurgy, The University, Liverpool, at 7.0 p.m.)

9 March. London Local Section. Fourth Annual Informal Dinner. (The Horse Shoe Hotel, Tottenham Court Road, London, W.1.)

13 March. Scottish Local Section. "Metallurgy and Musical Instruments", by W. H. Tait, followed by the Annual General Meeting. (Institution of Engineers and Shipbuilders, Elmbank Crescent, Glasgow, C.2, at 6.30 p.m.)

15 March. Liverpool Metallurgical Society. Visit to the Kirkby Works of Yorkshire Imperial Metals, Ltd.

15 March. North East Metallurgical Society. "Properties of Metals at Very Low Temperatures", by Dr. C. J. Adkins. (Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough, at 7.30 p.m.)

16 March. Birmingham Local Section. "Choosing a Stainless Steel", by H. T. Shirley. (College of Technology, Gosta Green, Birmingham 4, at 6.30 p.m.)

16 March. Sheffield Local Section. Chairman's Address and Annual General Meeting. (Applied Science Building, The University, St. George's Square, Sheffield, at 7.30 p.m.)

21 March. South Wales Local Section. Annual General Meeting, followed by Chairman's Address. (Metallurgy Department, University College, Singleton Park, Swansea, at 6.30 p.m.)

21 March. West of England Metallurgical Society. "Physical Methods of Analysis", by K. M. Bills. (The College of Technology, Ashley Down, Bristol 7, at 7.30 p.m.)

23 March. Southampton Metallurgical Society. Annual General Meeting, followed by "Metallurgy of Ferrous Welding", by Dr. R. G. Baker. (Southampton University, at 7.15 p.m.)

UNIVERSITY OF SYDNEY

CHAIR OF METALLURGY

Applications are invited for a recently established Chair of Metallurgy within the Faculty of Engineering. The successful applicant will be responsible for the teaching of, and research in, Metallurgy and Metallurgical Engineering.

Salary will be at the rate of £A4,250 per annum, plus cost of living adjustments. There is retirement provision under either the Sydney University Professorial Superannuation Scheme or the New South Wales State Superannuation Scheme.

Under the Staff Members' Housing Scheme, in cases approved by the University and its Bankers, married men may be assisted by loans to purchase a house.

The Senate reserves the right to fill the Chair by invitation.

A statement of Conditions of Appointment and Information for Candidates may be obtained from the Secretary, Association of Universities of the British Commonwealth, 36 Gordon Square, London, W.C.1.

Applications close, in Australia and London, on *15 March, 1961.*

INDUSTRIAL TRAINING APPOINTMENT

HENRY WIGGIN & COMPANY LIMITED

Applications are invited from Graduates (preferably in Metallurgy), 25–35 years of age, for the position of

Assistant to The Education & Training Officer

The administrative duties will include Operator, Apprentice, Graduate, and Supervisory Training within a modern and expanding Works at Hereford. Some experience of industry is desirable, together with a genuine interest in people. Salary according to qualifications and experience.

The Company provides excellent canteen, recreational, and other welfare facilities, and operates generous non-contributory pension and life assurance schemes.

Applications should be made in writing, giving full details, to The Personnel Manager, Henry Wiggin & Company Limited, Holmer Road, Hereford (quoting reference T.1.).

A VACANCY EXISTS in the Materials Laboratory for general metallurgical development work to cope with the increasing activities of the Company.

Applications will be considered from Metallurgical Graduates or those with H.N.C. in the subject. Qualified Mechanical Engineers with interest in materials may also be considered. The contemplated age range is 22–27 years. Salary will be dependent on age and experience. Applications should be in tabulated form and addressed to: Personnel Manager, Dowty Rotol Ltd., Cheltenham Road, GLOUCESTER.

BTP TITANIUM PIGMENTS

British Titan Products CO. LTD.

invites applications for the post of

METALLURGICAL CHEMIST

for its Technical Department, Billingham, Co. Durham. This is a new appointment in the technical organization of the Company and had been set up to deal with corrosion problems associated with the chemical processes of manufacture, as well as to develop the uses of new materials of construction.

The post should be of interest to graduates in Metallurgy who have had several years' experience in the field of corrosion.

Conditions of service in the Company are considered well above average and include such benefits as Non-contributory Superannuation Scheme, housing and removal assistance, etc.

Graduates who are interested in the above appointment should write to:

The Personnel Manager,
British Titan Products Company Limited,
Billingham, Co. Durham.

quoting reference S.21